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Production management decision-making and risk analysis of beef cattle breeders in Buru District, Maluku Province, Indonesia

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Abstract

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Decision-making in livestock business activities is the main responsibility of farmers. The success of the beef cattle farmer's business to achieve the highest profit is the main goal. How to take the right decision to achieve these goals and know the various risks in uncertainty, is an important input. This research was conducted on beef cattle breeders in Lolong Guba District, Buru Regency, Maluku Province, Indonesia aiming to determine the impact of various changes in the determinants of cattle breeders' profits and the risks posed by these changes to make decisions for farmer managers. The data collected is primary data recorded in nominal values. Data were analyzed by multiple linear regression model, followed by simulation analysis, and ended with risk analysis. The results of the study met the established hypothesis and were tested statistically significantly. The elasticity of value-added livestock is the largest compared to total sales. The biggest impact of increasing profit is through the increase in the value-added of livestock and the number of sales, although neither is the best choice. Farmer managers' options for dealing with risks and uncertainties in the future are to increase the cost of feeding, add value to livestock, and sell cattle. Mitigation is needed for options, namely farmer managers increasing livestock grazing time, providing supplementary food, monitoring livestock health, and avoiding livestock from environmental disturbances and accidents. Farmer managers need to be equipped with technical knowledge of body weight and carcass estimation of livestock.

Keywords: decision making; profit; simulation; risk and mitigation; beef cattle

Introduction

Decision-making in business activities is crucial for a businessman. Business activities are filled with various decisions that determine future business success. Making the right and accurate decisions will encourage various business activities to be carried out openly to achieve the best results. On the other hand, wrong decision-making causes the failure of business activities and results in losses.

Beef cattle farming is a business activity for farmers in Lolong Guba District, Buru Regency, Maluku Province. It is known that this breeder initially emerged with a traditional business that was carried out on the side to be family savings. When there is an urgent family need, the beef cattle that are kept can be sold. In its development, the number of cattle is increasing along with maintenance from year to year. On the other hand, inter-island cattle buyers continue to visit farmers to buy cattle and sell them to slaughterhouses in the provincial capital. The presence of buyers of cattle to the location of farmers opens up opportunities for farmers to be more intensive in developing their business to be marketed. Breeders act as managers in the beef cattle business that is carried out.

Managers are central actors in business decision-making. In making decisions, managers need accurate information about the conditions of the business being carried out. The information available in good capacity is very supportive of business decisions and makes farm managers successful in achieving the desired production (Remenova and Jankelova, 2019). The success of the farm manager also depends on his ability to process all the necessary business information. Less capable managers can use the wrong information or can ignore quality information that is certainly very useful for achieving success.

Managers themselves can make business decisions for success both in the short and long term. Short-term business decisions are immediate to achieve short-term business goals. Activities that are immediately carried out by managers to fulfil short-term business processes include providing sufficient raw materials for business operations, providing working manpower, ensuring the flow of raw materials and production factors so that they are available on time and as needed, providing the necessary costs, and carry out the production process according to the business being run (Kumar et al., 2020; Feng and Chan, 2019).

In the long term, managers are obliged to manage important matters to further increase profits, increase investment capacity, and sustainable production. Failure to achieve a decent profit can result in business activities losing money and even closing. The role of profit in management administration is to support business performance so that it can survive and succeed in the future (Kothari et al., 2016).

The achievement of a certain amount of profit is an important indicator of business activity. The amount of profit is the difference between receipts and expenses or costs. The profit indicator is used as an indicator that business actors will be encouraged to work harder to produce more now and in the future. Thus, the profit indicator provides useful motivation for business actors to further develop their business (Lowe et al., 2020). Profit indicators also contain meaning as an idea is how business actors focus and focus on the business activities they do. In this case, profits encourage business actors to invest in future business development. The certainty of receiving profits in business activities is widely useful in making decisions on the business expansion (Shackle, 2017).

Farmers as managers of beef cattle farms in Lolong Guba are faced with making decisions to manage their livestock business well to achieve the highest profit. In the short term, the activities of feeding and raising livestock are the focus of farmers. The time spent grazing livestock in the field has consequences for maintenance costs because the availability of forage and labor is valued in implicit values. In the long-term goal in the future, the ability of farmers to maintain the number of cattle that are kept and sell a certain amount is the next consideration. Even considering the number of cattle that will be increased with the current breeding and fattening of cattle for sale, it is an open option to increase the added value of livestock (savings). The amount of profit that farmers want to achieve with a certain selling amount and with an ideal ready-to-sell weight is the main consideration for obtaining large profits. All these considerations of farmers as managers require user input in decision-making.

Various decision options that become additional information for farmer managers pursuing the greatest profit achievement are how big the current business size and value-added livestock is, the total cost of food/rearing, and the number of sales that depend on the purchase of intermediary traders. Various options for setting these indicators pose a certain amount of risk in achieving profit. Therefore, information with good analysis can help farmer managers make the right decisions.

This study aims to determine the impact of various changes in the determinants of farmer profits and the risks posed by these changes in the context of making farmer managers' decisions.

Materials and Methods

Location and Data

The analysis of this research was conducted on beef cattle breeders in Lolong Guba and Waelata Districts, Buru District, Maluku Province, Indonesia. Data was collected from farmer information in 2021 and estimated in 2022. Buru Regency, Maluku Province is one of the targeted districts for beef cattle development and becomes a beef cattle barn for regional needs (Agricultural Research and Development Agency, 2020). The two sub-districts were taken by purposive sampling because they are the areas that have the largest cattle population and intensively sell cattle (Central Bureau of Statistics of Buru Regency, 2021). The sample breeders were selected by as many as 30 people and are actors who intensively sell cattle to inter-island traders. Conditions at the research site indicate that farmers who intensively sell livestock are those who have succeeded in doubling the number of livestock for the purpose of selling. Farmers who do not succeed in doubling the number of cattle are unable to sell cattle to intermediary traders with the desired body weight. The data collected is primary data, derived from farmer information, which is then recorded as nominal data. The analyzed data is transformed into the form of a normal logarithm. The variables analyzed in this study include farmer profits, added value, cost of forage, and total sales.

Analysis Methods

Multiple Linear Regression

To find out the various coefficients of the analyzed variables, a multiple linear regression model was built with the following equation:

$$\text{Ln LabPtr} = \beta_0 + \beta_1 \text{ Ln NTPtr} + \beta_2 \text{ Ln CostMak} + \beta_3 \text{ Ln QSelPtr} + \varepsilon \ldots\ldots \quad (1)$$

Information:

Ln LabPtr = Livestock profit (IDR)
Ln NTPtr = Value added cattle (IDR)
Ln CostMak = Cost of forage (IDR)
Ln QSelPtr = Total sales of cattle (kg)
$\beta_0; \beta_1 - \beta_3$ = Constant; Parameter value of each variable
ε = Error term.

Several measurement approaches to estimate the value of the variables covered include: (1) farmer's profit is the difference between the total cost of production and the added value of livestock plus the selling value of cattle, (2) the value-added of livestock is measured according to the live value of the livestock when sold according to age per head cattle, (3) the cost of food is estimated according to the implicit values of forage consumption per day according to the implicit value of workers grazing cattle per day, these values are calculated for one year, and (4) the number of sales of cattle is measured based on the agreement on the estimated carcass weight per head cattle by intermediary traders and breeders, the amount of this carcass estimate determines the selling price of cattle. The hypothesis that is built in the regression equation above is that the higher the added value of livestock (β_1) and the higher the number of cattle sales (β_3), the higher the profit obtained, on the contrary, the higher the cost of forage (β_2), the lower the profit received breeder.

Simulation Analysis

Simulation is a test step carried out by changing (increasing or decreasing) the value of an independent variable to determine the impact of its changes on the dependent variable. The simulated variables in this analysis include all independent variables which are increased by 10%. Consideration of a 10% increase in all independent variables based on the efforts of the farmer manager to pursue the target of increasing bodyweight of livestock for sales purposes. To achieve this target, farmers start by increasing the grazing time by 2 hours per day to provide sufficient grazing opportunities for their livestock. The activities of these farmers are accounted for in increasing the implicit values of costs. The intensity of livestock grazing activities results in an increase in added value because the livestock gains weight and also has the potential to increase the estimated carcass weight in sales. All the effects of these farmer activities lead to the achievement of profit which is the ultimate goal. Thus, the expected profit can be obtained through simulation analysis of increasing the added value of cattle, food costs, and the number of sales of cattle.

Risk Analysis

In general, the risk is defined as an adverse event or deviation from the expected results (Arifudin et al., 2020). Risk is also defined as opportunities and scenarios or consequences or the severity of consequences that occur in a real-world situation. In this case, the risk is a combination of hazards measured by the probability and size of the likelihood and severity of harm (Aven, 2012). Related to the methodology, risk has procedures as (1) identifying systems that represent potential sources of hazards; (2) identifying the nature of any potential hazard generated by the possible abnormal state of the source system; and (3) selecting attractive targets and assessing the types of adverse effects experienced (Andretta, 2014).

By the definition of risk above, risk analysis is carried out according to the simulation results that have an impact on the profits of farmers. Based on the magnitude of the impact, it will be known the risk posed to the farmer's profit if certain decisions are taken. These results are useful as information for farmer managers in making decisions.

Results and Discussion

Multiple Regression Analysis

Before analyzing decision-making, the analysis begins with multiple regression to determine the parameter values of the influence variables. According to the statistical concept, the results of the analysis of a model are called "valid" if they meet the requirements of "classical assumptions". In this case, the estimation using the Ordinary Least Square (OLS) method must meet all the classical assumptions to give the estimation results of BLUE (Best Linear Unbiased Estimates). The classical assumption requirements include (1) residual data from the linear regression model has a normal distribution, (2) there is no multicollinearity among independent variables, (3) the regression model does not contain heteroscedasticity, and (4) there is no autocorrelation (Das, 2019; Latan and Selva, 2013).

The data normality test can be done with the One-Sample Kolmogorov-Smirnov test to determine whether the residual data from the linear regression model are normally distributed. The multicollinear test aims to determine whether there is a correlation between the independent variables in the model. To determine the presence or absence of multicollinearity, by looking at the value of Tolerance and VIF (Variance Inflation Factor). The heteroscedasticity test aims to determine whether the variance of the residual data from one observation to another is different or not. If the variance of the residual data is the same (not different) then it is called homoscedasticity which means, there is no heteroscedasticity. A good regression model does not contain heteroscedasticity. Testing heteroscedasticity can be done with the Glejser test. While the autocorrelation test can only be done if the research data is time-series data. The analysis in this study does not use time-series data but cross-section data, therefore the autocorrelation test does not need to be carried out.

The results of the classical assumption test are presented respectively in Tables 1-3 below. The results of the One-Sample Kolmogorov-Smirnov Test statistical test can be seen in Table 1. The results of the One-Sample Kolmogorov-Smirnov Test statistical test show the Asymp value. Sig. (2-tailed) of 0.200 where > 0.05. From this significance value, it can be concluded that the residual data from the regression model are normally distributed.

The results of the multicollinearity test in Table 2 show the Tolerance value of the three independent variables including the value-added of cattle (LnNTPtr), and the cost of forage grass (LnCostMak), and the number of cattle sales (LnQSelPtr) is greater than 0.10. The VIF value of the three variables is < 10, so it is concluded that there is no multicollinearity among the independent variables.

The results of the Glejser statistical test in Table 3 show that all independent variables have a significant value > 0.05, which means that there is no heteroscedasticity in the regression model.

In Tables 4 – 6, the results of the multiple regression analysis of the farmer's profit model are presented.

Table 1. Results of the One-Sample Kolmogorov-Smirnov Test

One-Sample Kolmogorov-Smirnov Test		
		Unstandardized Residual
N		30
Normal Parameters[a,b]	Mean	0.0000000
	Std. Deviation	27097.22963082
Most Extreme Differences	Absolute	0.099
	Positive	0.099
	Negative	-0.099
Test Statistic		0.099
Asymp. Sig. (2-tailed)		0.200[c,d]
a. Test distribution is Normal.		
b. Calculated from data.		
c. Lilliefors Significance Correction.		
d. This is a lower bound of the true significance.		

Source: Results of computer printout analysis

Table 2. Results of Multicollinearity Test

Coefficients								
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	1.153	1.282		0.899	0.377		
	LnNTPtr	1.701	0.075	1.030	22.603	0.000	0.195	5.138
	LnCostMak	-1.002	0.099	-0.591	-10.101	0.000	0.118	8.459
	LnQSelPtr	0.535	0.055	0.534	9.791	0.000	0.136	7.359
a. Dependent Variable: LnLabPtr								

Source: Results of computer printout analysis

Table 3. Results of Heteroscedasticity Test (Glejser Statistical Test)

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.081	0.745		1.451	0.159
	LnNTPtr	-0.133	0.044	-1.148	-3.034	0.060
	LnCostMak	0.068	0.058	0.575	1.184	0.247
	LnQSelPtr	0.024	0.032	0.336	0.742	0.465
a. Dependent Variable: Glejser						

Source: Results of computer printout analysis

Table 4. Statistical Value of the Coefficient of Determination (R^2)

Model Summary[b]				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.995[a]	0.989	0.988	0.060004343
a. Predictors: (Constant), LnQSelPtr, LnNTPtr, LnCostMak				
b. Dependent Variable: LnLabPtr				

Source: Results of computer printout analysis

Table 5. F Statistical Test Value

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	8.812	3	2.937	815.824	0.000[b]
	Residual	0.094	26	0.004		
	Total	8.906	29			
a. Dependent Variable: LnLabPtr						
b. Predictors: (Constant), LnQSelPtr, LnNTPtr, LnCostMak						

Source: Results of computer printout analysis

Table 6. Statistical Values of Estimation Parameters and *t*-Test

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.153	1.282		0.899	0.377
	LnNTPtr	1.701	0.075	1.030	22.603	0.000
	LnCostMak	-1.002	0.099	-0.591	-10.101	0.000
	LnQSelPtr	0.535	0.055	0.534	9.791	0.000
a. Dependent Variable: LnLabPtr						

Source: Results of computer printout analysis

The estimation above gives the following multiple linear regression equation results:

$$LnLabPtr = 1.153 + 1.701\ LnNTPtr - 1.002\ LnCostMak + 0.535\ LnQSelPtr$$

The estimation results fulfill the research hypothesis (a priori hypothesis) that the higher the added value and the higher the number of livestock sales, the higher the profit earned. On the other hand, the higher the cost of forage, the lower the profit. The added value of livestock and the number of sales are important variables in influencing the increase in profit (Gedikoglu and Parcell, 2009; Al-Taha'at, et al., 2017). Added value provides additional value for the revenue share of cattle breeders which then increases the potential profit that will be obtained by farmers. Meanwhile, the number of sales will directly increase sales revenue so that it has the potential to increase profits. On the other hand, additional costs reduce the amount of profit received.

To find out whether the results of the regression analysis are statistically feasible, the related statistical indicators need to be proven to meet the test and get the appropriate interpretation. The value of the coefficient of determination (R^2) in Table 4 is 0.989, which means that 98.90% of the variation in the farmer's profit variable (LnLabPtr) can be explained by the variation of the added value variables, the cost of forage, and the number of cattle sales together. The test to find out whether the R^2 value is significant or not is indicated by the F statistical test (Abebe, 2019). The results of the F test in Table 5 show a value of 0.0001 which means it is very significant.

To find out whether each independent variable significantly or does not affect the farmer's profit, the t statistic test is carried out (Kim, 2015). The estimation results in Table 6 show the probability value of *t* for the value-added variable, the cost of forage, and the number of sales each worth 0.0001, which means that all variables significantly affect the farmer's profit.

The result of parameter estimation using normal logarithm data will show elasticity. The value-added parameter of 1.701 means that an increase in the added value of 1% will increase profits by 1.70% (elastic). Forage cost parameter value of -1.002 means that an increase in forage costs of 1% will decrease profit by 1.0% (unit elastic). The parameter value of the number of cattle sales of 0.535 means that an increase in the number of sales by 1% will increase profits by 0.535% (inelastic). Of the three variables that affect the farmer's profit, the value-added variable has the largest elasticity, meaning the added value is the largest contributor to the farmer's profit. Meanwhile, the increase in forage costs has the same magnitude of effect on the reduction in farmer profits.

Simulation Analysis

The simulation results of an increase in each of the independent variables by 10% are presented in Table 7 below.

The simulation results of an increase of 10% on each of the independent variables that have an impact are (1) the added value of livestock has an impact on increasing farmers' profits by 17.47%; (2) forage costs have an impact on lowering profits 9.70%; (3) the number of cattle sales has an impact on increasing profits by 1.53%; (4) the added value of livestock and forage costs have an impact on increasing profits by 7.77%; (5) the added value of livestock and the number of cattle sales have an impact on increasing profits by 18.99%; (6) the cost of forage and the number of sales of cattle have an impact on lowering profits by 8.17%; and (7) the added value of livestock, forage costs, and the number of cattle sales have an impact on increasing profits by 9.39%. The scenario of increasing the independent variable individually which has the biggest impact on increasing profits (positive) is the added value of livestock, followed by the number of cattle sales. Meanwhile, the increase in forage costs resulted in a 9.70% decrease in profit.

The combined scenario that has the biggest impact on increasing farmer profits is the value-added of livestock and the number of cattle sales, which is 18.99%, followed by the added value of livestock, the cost of forage, and the total sales of cattle by 9.39%, then followed by the value-added of livestock and the cost of forage by 7.77%. Meanwhile, the combined scenario of an increase in forage costs and the number of cattle sales has an impact on reducing profits by 8.17%.

Based on the magnitude of the resulting impact, it is known that the variable that has the biggest role in increasing farmer profits is added value. On the other hand, an increase in the number of livestock sales has played a minor role. An increase in forage costs automatically lowers the farmer's profit. The added value is the value of live cattle in the farmer's business and is cultivated by the breeder through cattle fattening. Breeders who have succeeded in increasing the bodyweight of cattle in the fattening stage, provide additional value for live cattle even though they have not been sold. In this case, the added value of livestock has provided additional profits to farmers in the form of livestock savings (implicit value) (Heatubun et al., 2020).

The increase in forage costs in the current cattle business has a role in long-term profits. But by increasing the intensity of livestock grazing, the consequence is an increase in the value of the cost (implicit). Therefore, the increase in forage costs has a direct impact on reducing current profits (Sirajuddin et al., 2015). However, in the future, the actual cost increase has the potential to increase profits through additional value-added and weight/carcass gain at the sales stage.

Risk Analysis

As stated earlier that risk is an opportunity and a scenario or consequence or the severity of the consequences that occur in a real-world situation (Aven, 2012). Risk also means a state of uncertainty that can arise in an activity (Zinn, 2016). As stated above, the measurement of the magnitude of the impact in the simulation above carries a risk to the potential profit received by farmers. In making decisions, farmer managers can set various options (scenarios) to get clear information about the expected goals. Beef cattle farmers in Lolong Guba have options available to pursue increased

Table 7. Simulation Results of 10% Increase in Independent Variables

Scenario	Profit Change (%)	Breeder's Profit Value (IDR)
1. Added value of livestock	17.47	17.356.506.36
2. Forage costs	-9.70	13.342.065.50
3. Number of cattle sales	1.53	15.001.327.91
4. Added value of livestock and forage cost	7.77	15.923.304.53
5. Added value of livestock and number of sales of cattle	18.99	17.581.089.41
6. The forage cost and number of sales of cattle	-8.17	13.568.127.07
7. Added value of livestock, forage cost, and number of cattle sales	9.39	16.149.366.10
Breeder's Average Profit: IDR 14.775.266.33		

Source: Results of data analysis

profits through value-added livestock (as savings) or increase the number of cattle sales, or can also increase forage costs. The choice of breeders to increase added value has the risk of increasing the highest profit of 17.47% of the average value. This may be the best choice for breeders. If the farmer's profit increases through increasing the number of cattle sales, this option risks only increasing profits by 1.53% of the average. And the worst option with high risk reduces the potential profit the farmer would expect if he choses to increase forage costs.

Individually the best option is an increased value-added and the worst is increased forage costs. However, the increase in added value cannot occur if the farmer does not seek fattening which is done through additional feeding through a more intensive (longer) time to graze livestock. The need for longer grazing times has the consequence of increasing forage costs (implicit valuation). Therefore, the option of increasing added value individually cannot occur in raising cattle breeders without increasing forage costs. If the breeder only adds to the sale of cattle without fattening, it cannot provide a high selling value that increases profit. Because the sale of cows that do not have an ideal body weight (not fat) will provide a low selling value. So, the individual scenario is not a real condition that can be done by farmers.

Farm managers should turn to combination options that naturally apply as they are. The combination scenario in Table 7 that gives the largest increase in profit is an increase in added value followed by an increase in sales. However, as explained earlier, the choice of combination is unlikely to occur if it is not preceded by an increase in forage costs. Therefore, the most relevant scenario choice made by farmer managers to increase profits is to increase the time of grazing livestock in the field so that livestock graze more intensively. This activity has the same consequences as an increase in forage costs (implicit valuation). Through this increase in forage costs, an increase in livestock value-added can occur and has the potential to increase the selling weight of livestock when livestock are sold to intermediary traders. Here's a selection of the best-case scenarios that farmer managers can take to achieve the goal of the greatest profit potential.

In terms of facing risks and finding the right solution in decision-making, farmer managers can mitigate. Mitigation is defined as an activity carried out to reduce unwanted impacts in achieving the best-desired results (Bedoya, 2020; Hayudityas, 2020). Following the meaning of mitigation, farmer managers to implement the best scenario to achieve the greatest profit as expected, need to take several intensive actions. The actions referred to include more frequent and intensive grazing of livestock, supplementary feeding can be carried out, supervision of livestock health must be more intensive, and supervision of livestock from various environmental disturbances and accidents needs to be avoided. Farmer managers also need to be given technical knowledge about body weight and carcass estimation of beef cattle so that they can be used in the bargaining process for carcass weight estimation with intermediary traders when cattle are sold.

Conclusions

From the findings and discussion in this study, several conclusions were drawn as follows:

The results of the regression analysis meet the research hypothesis, the higher the added value of livestock and the number of cattle sales, the higher the profit earned, on the contrary, the higher the cost of forage, the lower the profit. This hypothesis was tested as statistically significant.

Value-added livestock has the greatest elasticity of increasing profit compared to total sales, while forage costs have unit elasticity with profits in the opposite direction (negative).

The biggest profit increase impact is provided through a combination of increasing the value-added of livestock and the number of cattle sales. An increase in forage costs directly impacts lowering a sizeable percentage of profits.

In terms of facing risk as future uncertainty, farmer managers can take current decision options that have the opportunity to provide increased profits in the future. The decision options that are relevant to the current situation of farmers are increasing the cost of providing forage, increasing the added value of livestock, and increasing cattle sales.

Mitigation that can be done by cattle farmer managers to achieve the highest profit is to graze livestock more frequently and intensively, provide supplementary food, more intensively monitor livestock health, avoid livestock from various environmental disturbances and accidents, and farmer managers need to be equipped with technical knowledge of assessment body weight and carcass of livestock.

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